Systematic Review and Meta-Analysis

Medicine

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# Efficacy of electroacupuncture in the treatment of insomnia in cancer patients

## A meta-analysis

Ke Li, MM[a,*], Ying Luo, MM[a]

**Abstract**

**Background:** The purpose of this meta-analysis of current studies was to assess the efficacy of electroacupuncture for cancer-related insomnia.

**Methods:** A comprehensive search was conducted encompassing randomized controlled trials examining the efficacy of electroacupuncture in treating cancer-related insomnia across CNKI, VIP, Wang Fang, PubMed, Embase, Cochrane library, and Web of Science, with a search deadline of December 26, 2023. The Cochrane manual's risk-of-bias evaluation was used for quality assessment, while Stata 15.0 was used for the data analysis.

**Results:** Eight randomized controlled studies involving 537 individuals were finally included. Meta-analysis results suggested that electroacupuncture improved total sleep time [SMD = 0.68, 95% CI (0.31, 1.06)], sleep efficiency [SMD = 1.26, 95% CI (0.02, 2.50)], and reduced Pittsburgh sleep quality index [SMD = –0.44, 95% CI (–0.63, –0.25)], insomnia severity index [SMD = –1.23, 95% CI (–1.88, –0.58)], and sleep onset latency [SMD = –0.76, 95% CI (–1.36, –0.15)] in cancer patients.

**Conclusion:** Based on the current study, we found that electroacupuncture may have a better effect on insomnia in cancer patients.

**Abbreviations:** CG = control group, CI = confidence interval, CNKI = China National Knowledge Infrastructure, EA = electroacupuncture, EG = experimental group, F1 = Pittsburgh sleep quality index, F2 = total sleep time, F3 = insomnia severity index, F4 = sleep onset latency, F5 = sleep efficiency, GRADE = graded recommendations assessment development and evaluation, ISI = insomnia severity index, M/F = male/female, PSQI = Pittsburgh sleep quality index, RR = risk ratio, SE = sleep efficiency, SMD = standardized mean difference, SOL = sleep onset latency, TST = total sleep time.

**Keywords:** cancer, electroacupuncture, insomnia, meta-analysis, PSQI

## 1. Introduction

In recent years, with the rapid growth of the population base and aging aggravation, the incidence and mortality of cancer have been increasing rapidly worldwide, which seriously jeopardizes human health.[1] Cancer patients not only have to face physical discomfort, but also must bear the economic burden, self-image disorders, anxiety and depression, and other psychological stress, which is a stress that seriously affects the patient's quality of sleep.[2,3] In cancer patients, the prevalence of insomnia ranges from 30% to 93.5%,[4,5] which is 3 times higher than that in the general population (9% to 33%).[6] Insomnia is a clinical syndrome caused by disorders of sleep and wakefulness rhythms and abnormal sleep quality, and it is a common clinical symptom in cancer patients during diagnosis and treatment, with difficulty in falling asleep, sleep disruption and daytime fatigue as the main manifestations.[7,8] Insomnia is an important factor affecting the health and quality of life of individuals. The occurrence of sleep disorders in cancer patients not only aggravates the decline of various physiological functions and cognitive levels and accelerates the development of psychological symptoms,[9,10] but also affects the recovery of the disease and reduces the quality of life of the patients, which is an obvious harm to the patients.[11] Moreover, tumor treatment will produce side

*This work was supported by Key Project of Higher Education Teaching Reform Research and Practice in Henan Province (2024SJGLX0683), Key Project of the 2024 Annual Planning by the Chinese Society for Vocational Education (ZJS2024ZD56), and Project of Vocational Education Teaching Reform Research and Practice in Henan Province (Yu [2024]05842).*

*No ethical requirements were required for this study, so no human beings/animals were involved in the meta-analysis.*

*The authors have no conflicts of interest to disclose.*

*All data generated or analyzed during this study are included in this published article [and its supplementary information files].*

*Supplemental Digital Content is available for this article.*

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*How to cite this article: Li K, Luo Y. Efficacy of electroacupuncture in the treatment of insomnia in cancer patients: A meta-analysis. Medicine 2025;104:1(e41123).*

*Received: 6 February 2024 / Received in final form: 6 December 2024 / Accepted: 11 December 2024*

*http://dx.doi.org/10.1097/MD.0000000000041123*

effects such as nausea, vomiting and hair loss, and patients are prone to negative emotions such as anxiety, fear, and depression, which will lead to insomnia, and insomnia will have a negative impact on the treatment of patients with tumors, which will make patients fall into a vicious cycle.[12]

At present, western medicine treatment of insomnia often uses drugs and non-pharmacological treatment in 2 ways: drugs mainly include mirtazapine, non-benzodiazepine, benzodiazepine.[13] Research shows that long-term use of drugs will appear drug resistance and drug dependence, so the

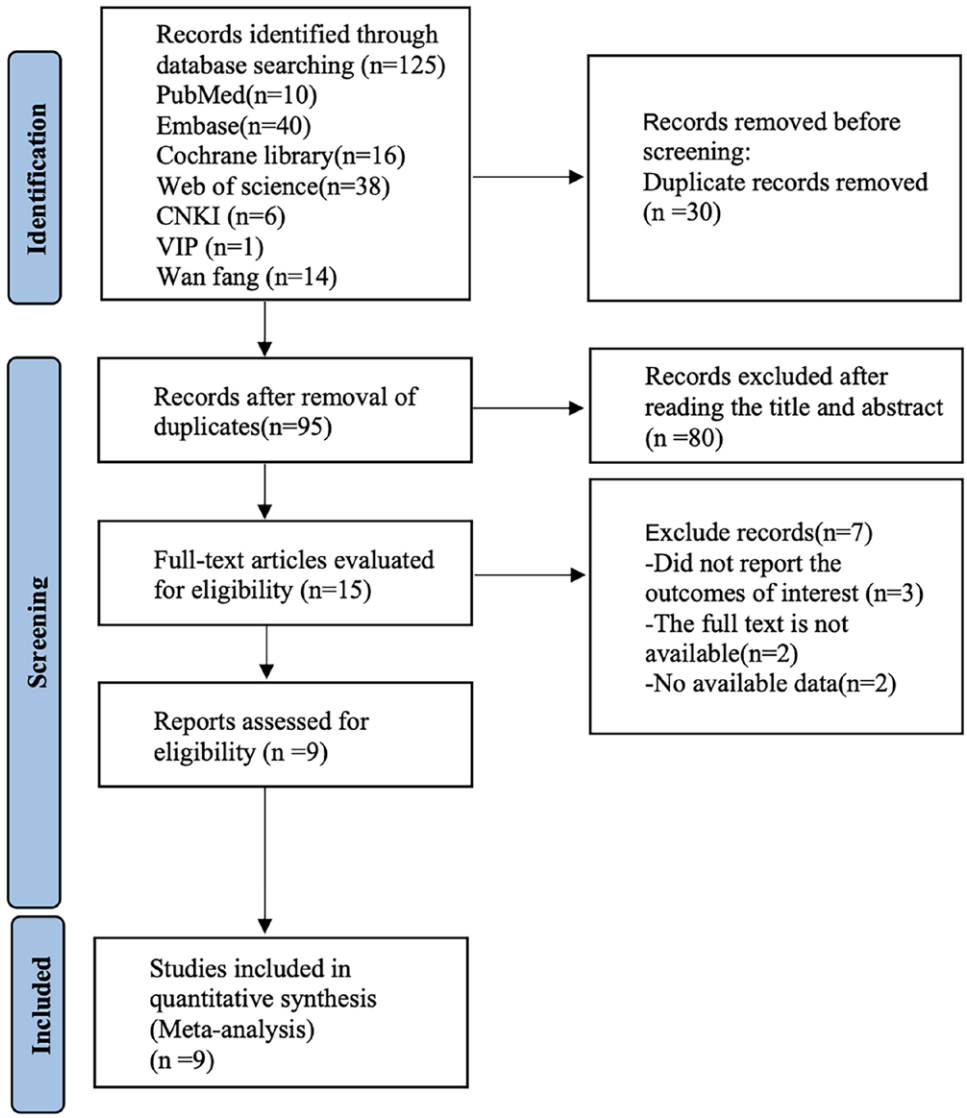


**Figure 1.** Literature search flow chart.

**Table 1**

**Baseline characteristics table.**

| Study | Year | Country | Sample size | | Gender (M/F) | Cancer stage | Mean age (yr) | | Intervention | | Outcome |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | EG | CG | | | EG | CG | EG | CG | |
| Garland | 2017 | Canada | 30 | 28 | 0/58 | Breast cancer 0 to III | 52.9 | 50.4 | EA: 2 HZ, 30 min | 900 mg gabapentin | F1 |
| Lee | 2022 | Korea | 8 | 8 | 5/11 | Breast, thyroid, gastrointestinal, I to IV | 57.63 | 61.38 | EA: 4 HZ, 30 min | Usual care | F1; F2; F3; F4; F5 |
| Mao | 2014 | USA | 22 | 23 | 0/44 | Breast cancer I to III | 57.5 | 60.6 | EA, 30 min | Usual care | F1 |
| Tong | 2022 | China | 34 | 36 | 0/70 | Breast cancer I to III | 53.32 | 52.14 | EA: 10 to 25 HZ, 30min | Usual care | F2; F5 |
| Yang | 2023 | China | 110 | 48 | 42/116 | Breast, thyroid, gastrointestinal, I to IV | 60.2 | 61 | EA: 2 HZ, 30 min | Usual care | F1 |
| Zhang | 2021 | China | 15 | 15 | 0/30 | Breast cancer I to IV | 52.5 | 52.7 | EA: 2 to 5 HZ, 30 min | Usual care | F1; F2; F3; F4; F5 |
| Zhou | 2022 | China | 30 | 30 | 39/21 | Gastrointestinal, I to IV | 66 | 68 | EA: 2 HZ, 30 min | Usual care | F1 |
| Shen | 2016 | China | 50 | 50 | 59/41 | Lung cancer III to IV | 54.93 | 58.09 | EA: 10 HZ, 30 min | Usual care | F1 |

Abbreviations: CG = control group, EA = electroacupuncture, EG = experimental group, F1 = Pittsburgh sleep quality index, F2 = total sleep time, F3 = insomnia severity index, F4 = sleep onset latency, F5 = sleep efficiency, M/F = male/female.

long-term application of sleeping drugs is subject to certain limitations[14]; non-pharmacological treatment of insomnia, including sleep hygiene education, sleep constraints, stimulation of behavior and corrective therapies.[15,16]

Acupuncture therapy has the efficacy of dredging meridians and collaterals, regulating yin and yang, and supporting the positive and dispelling the evil.[17] Electroacupuncture is a modern acupuncture therapy that uses electroacupuncture therapeutic instrument to pass micro-pulse current based on the qi of the millimeter needle and imports electric current with different properties into the body to strengthen the acupuncture effect of the acupuncture points.[18] Currently, many studies have confirmed that electroacupuncture therapy has good efficacy in improving sleep quality and relieving pain, but its effectiveness in improving sleep quality in cancer patients is still controversial,[19] so the present study hopes to resolve the above controversy through meta-analysis and provide new options for clinical patient treatment.

## 2. Materials and methods

The systematic review described herein was accepted by the online PROSPERO international prospective register of systematic reviews[20] of the National Institute for Health Research (CRD42024497659) and followed PRISMA(the preferred reporting project for system review and meta-analysis scheme) guidelines.

### 2.1. Search strategy

Randomized controlled trials on electroacupuncture for insomnia in cancer patients were searched in CNKI, VIP, Wang Fang, PubMed, Embase, Cochrane library, and Web of Science, with a search deadline of December 26, 2023, using the mesh word combined with a free word: electroacupuncture, insomnia, cancer. Detailed search strategies are provided in Table S1, Supplemental Digital Content, http://links.lww.com/MD/O255.

### 2.2. Inclusion and exclusion criteria

The included population met the diagnostic criteria for insomnia in cancer patients.[21] electroacupuncture was used in the experimental group and other interventions were used in the control group, and the primary outcome were Pittsburgh sleep quality index (PSQI); total sleep time (TST); sleep efficiency (SE).; and the secondary outcome were insomnia severity index (ISI); sleep onset latency (SOL), the randomized controlled trial was included in this study.

Conference abstracts, meta-analyses, systematic reviews, animal experiments, Full text is not available and case reports will be considered for exclusion.

### 2.3. Data extract

Two authors (LK and YL) rigorously screened the literature based on predetermined inclusion and exclusion criteria. In case of any disagreement, they resolved it through discussion or sought the opinion of a third party to negotiate and reach consensus. Information extracted from the included studies included the following key details: authors, year, country, sample size, gender, mean age, type of disease, intervention, and outcome.

### 2.4. Grade of evidence

To determine the quality of our results, we selected the Graded Recommendations Assessment Development and Evaluation (GRADE) system to evaluate the evidence[22] for methodological quality. We considered 5 factors that could reduce the quality of the evidence, including study limitations, inconsistent findings, inconclusive direct evidence, inaccurate or wide CIs, and publication bias. In addition, 3 factors that could reduce the quality of evidence were reviewed, namely effect size, possible confounding factors, and dose–effect relationships. A comprehensive description of the quality of evidence for each parameter data is provided (Table S2, Supplemental Digital Content, http://links.lww.com/MD/O255).

### 2.5. Included studies' risk of bias

Two investigators (LK and YL) independently assessed the risk of bias as low, unclear, or high using the Cochrane Collaboration tools.[23] If there was any disagreement, a third person was consulted to reach consensus. The assessment included 7 areas: generation of randomized sequences (selective bias), allocation concealment (selective bias), blinding of implementers and participants (implementation bias), blinding of outcome assessors (observational bias), completeness of outcome data (follow-up bias), selective reporting of study results (reporting bias), and other potential sources of bias.

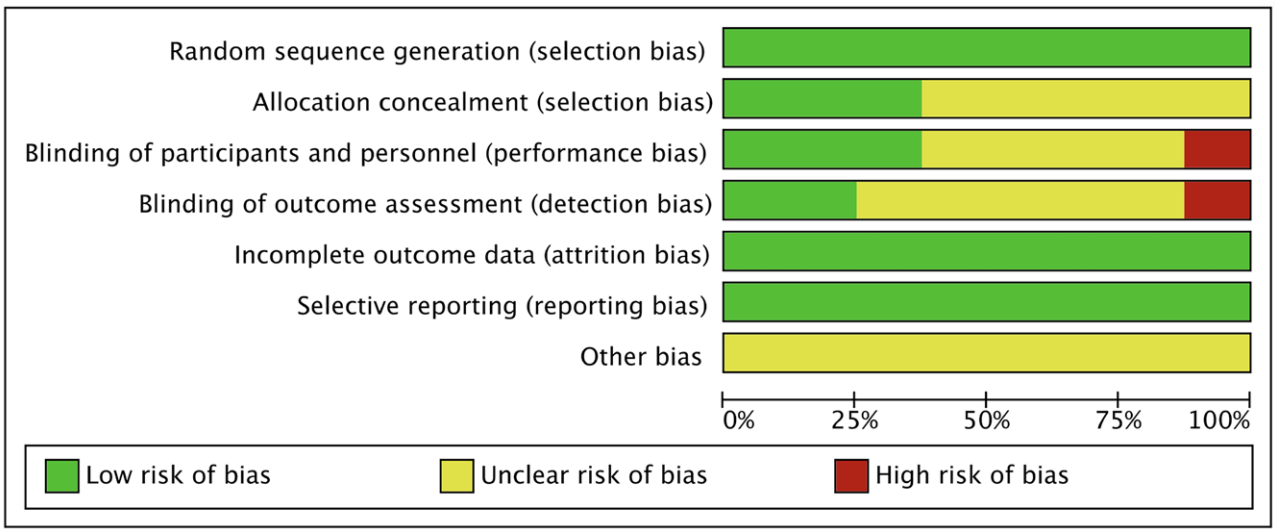


**Figure 2.** Risk bias of graph.

Each included study was assessed individually against these criteria. If a study fully met all criteria, it was at "low risk" of bias, indicating a high-quality study and low overall risk of bias. If a study partially met the criteria, its quality was categorized as "unclear risk," indicating a moderate likelihood of bias. If a study did not meet the criteria at all, it was categorized as "high risk," indicating a high risk of bias and low quality of the study.

### 2.6. Data analysis

The collected data were statistically analyzed using Stata 15.0 software (Stata Corp, College Station). Heterogeneity between included studies was assessed using $I^2$ values or $Q$-statistics. $I^2$ values of 0%, 25%, 50%, and 75% indicated no heterogeneity, low heterogeneity, moderate heterogeneity, and high heterogeneity, respectively. If the $I^2$ value was equal to or >50%, a sensitivity analysis was performed to explore potential sources of heterogeneity. If heterogeneity was <50%, analyses were conducted using a fixed-effects model. Standardized mean difference and 95% confidence interval (CI) were used for continuous variables and risk ratio (RR) and 95% CI for dichotomous variables. In addition, random effects model and Egger test were used to assess publication bias.

## 3. Results

### 3.1. Study selection

Figure 1 shows our literature search process, which initially retrieved 125 documents, removed 30 duplicates, removed 80 articles by reading titles and abstracts, removed 7 papers by reading the full text, and finally included 8 randomized controlled trials[24–31] for analysis.

### 3.2. Basic characteristics and risk of bias of the included studies

Eight randomized controlled studies involving 537 individuals were finally included, types of cancer include Breast, thyroid, gastrointestinal, the frequency of electroacupuncture was 2 to 25 Hz. Baseline characteristics are shown in Table 1 The 4 included studies clearly accounted for the method of randomization used, and the risk of bias results are shown in Figures 2 and 3.

### 3.3. Result of meta-analysis

***3.3.1. Pittsburgh sleep quality index.*** Seven articles[24–26,28–31] referred to the PSQI, with higher PSQI scores representing poorer sleep quality. Heterogeneity was tested ($I^2$ = 0%, $P$ = .443), therefore a fixed effect model was used for data analysis and the results of the analysis (Fig. 4) suggested that electroacupuncture reduced PSQI [SMD = –0.44, 95% CI (–0.63, –0.25)] improving sleep quality in oncology patients.

***3.3.2. Total sleep time.*** Three articles[25,27,29] referred to the TST. Heterogeneity was tested ($I^2$ = 0%, $P$ = .610), therefore a fixed effect model was used for data analysis and the results of the analysis (Fig. 5) suggested that electroacupuncture improving TST [SMD = 0.68, 95% CI (0.31, 1.06)].

***3.3.3. Insomnia severity index.*** Two articles[25,29] referred to the ISI, with higher ISI scores representing poorer sleep quality. Heterogeneity was tested ($I^2$ = 44.9%, $P$ = .178), therefore a fixed effect model was used for data analysis and the results of the analysis (Fig. 6) suggested that electroacupuncture reduced ISI [SMD = –1.23, 95% CI (–1.88, –0.58)] improving sleep quality in oncology patients.

***3.3.4. Sleep onset latency.*** Two articles[25,29] referred to the SOL. Heterogeneity was tested ($I^2$ = 0%, $P$ = .759), therefore a fixed effect model was used for data analysis and the results of the analysis (Fig. 7) suggested that electroacupuncture reduced SOL [SMD = –0.76, 95% CI (–1.36, –0.15)].

***3.3.5. Sleep efficiency.*** Three articles[25,27,29] referred to the SE. Heterogeneity was tested ($I^2$ = 86.9%, $P$ = .759), therefore a random effect model was used for data analysis and the results of the analysis (Fig. 8) suggested that electroacupuncture improving SE [SMD = 1.26, 95% CI (0.02, 2.50)], due to its heterogeneity, sensitivity analysis was conducted using 1-by-1 exclusion of the literature, and the results of the analysis suggested that SE was less sensitive and the results of the analysis were more stable.

### 3.4. Published bias

Publication bias was assessed by an Egger test for PSQI, TST, SE which showed no publication bias (Figs. S1–S3, Supplemental

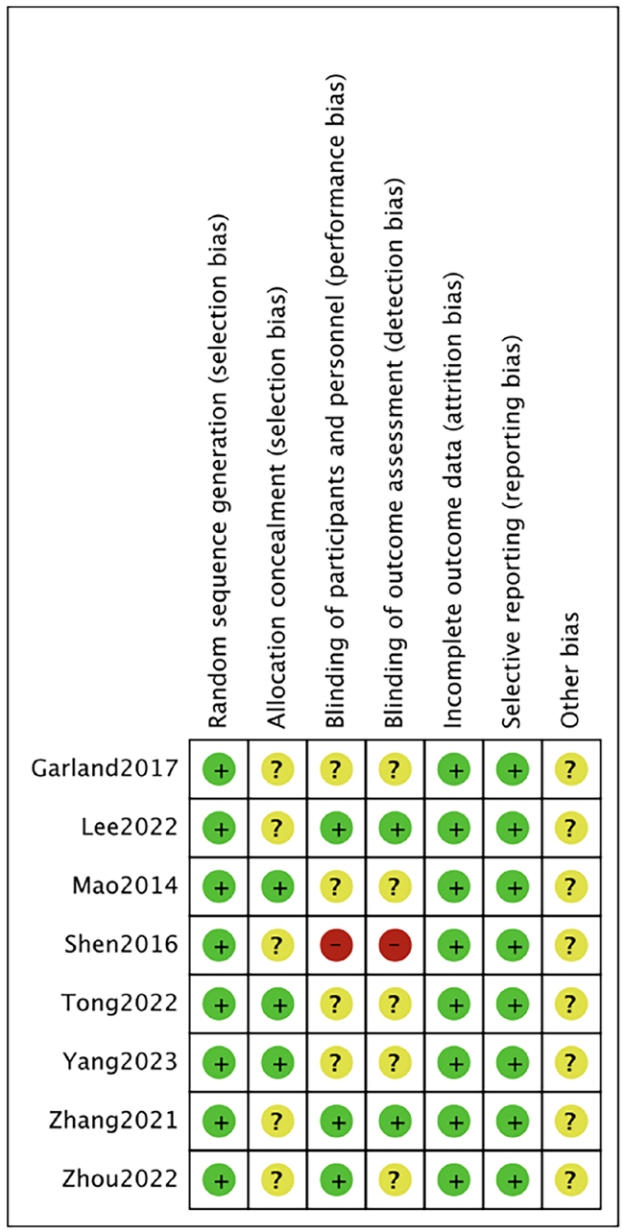


**Figure 3.** Risk bias of summary.

Digital Content, http://links.lww.com/MD/O256) for PSQI ($P$ = .469), TST ($P$ = .130), SE ($P$ = .485).

## 4. Discussion

To our knowledge, this is the first time that meta-analysis has been used to assess the efficacy of electroacupuncture in the treatment of insomnia in cancer. Our study found that electroacupuncture improved TST, SE, and reduced PSQI, ISI, and SOL in cancer patients, suggesting that electroacupuncture can improve sleep quality in cancer patients. Electroacupuncture for insomnia has the advantages of fewer adverse effects, quicker results, and precise efficacy.[32] Otte[33] reported that the quality of sleep in the electroacupuncture group was significantly better than that of the control group immediately after the 8-week intervention period, but this between-group difference disappeared after 4 weeks. However, according to Choi et al, the effects of acupuncture seem to increase over time.[34] These authors found acupuncture to be as good as conventional therapy. In the early 1970s, Han team made the first strong suggestion that the analgesic effect of acupuncture was related to central chemical mediators.[17] They transferred cerebrospinal fluid from acupuncture donor rabbits to recipient rabbits and achieved analgesic effects in recipient rabbits. Acupuncture and electroacupuncture have been shown to ameliorate insomnia by: decreasing sympathetic activity,[35] inhibiting the activation of the hypothalamic-pituitary-adrenal axis,[36,37] increasing the levels of gamma-aminobutyric acid (GABA) and GABA(A) receptors,[38] and increasing the production and secretion of melatonin.[39] Research[40] found that acupuncture can reduce the PSQI score and improve the clinical symptoms and signs of insomnia in insomnia patients. Some animal experiments found that acupuncture on Shenmen acupoint of rats may improve the behavioral and cognitive abilities and brain waves of sleep deprived rats. Acupuncture can also improve sleep quality by regulating sleep-awakening related factors such as IL-1β[41] and brain-derived nerve growth factor. Improve sleep quality. Electroacupuncture can regulate the expression of AMPK and the content of Ac-Coa and Na+-K+-ATPase in the paraventricular nucleus of the hypothalamus, adjusting the energy metabolism of the paraventricular nucleus of the hypothalamus, and thus improving the symptoms of insomnia and post insomnia fatigue.[42] Garland et al[24] found that the ISI was reduced by 8.3 and 10.9 points in the acupuncture and cognitive-behavioral therapy groups, respectively, after 8 weeks of treatment compared to pretreatment. In another study, Palesh et al[43] investigated the effectiveness of brief behavioral therapy on insomnia in breast cancer patients undergoing chemotherapy and found that 6 weeks of treatment reduced the ISI by approximately 5 points compared to pretreatment. Cancer survivors who completed active cancer treatment appeared to benefit more from acupuncture or behavioral therapy than those who were undergoing active treatment. Although the efficacy of acupuncture may be diminished by the persistence of triggers (active cancer treatment and its side effects), early intervention may play an important role in preventing worsening of insomnia given the negative health consequences of insomnia-cancer co-morbidity.

Our study outcome metrics were rated "low" on the GRADE scale, which may be due to the small number of included studies and the high degree of heterogeneity. This suggests that we should include more high-quality, multicenter, randomized controlled studies in future studies.

Although, our study demonstrated the efficacy of electroacupuncture for cancer-related insomnia, it still has several limitations: firstly, the number of included studies was small and the number of designed cases was small, which may affect the

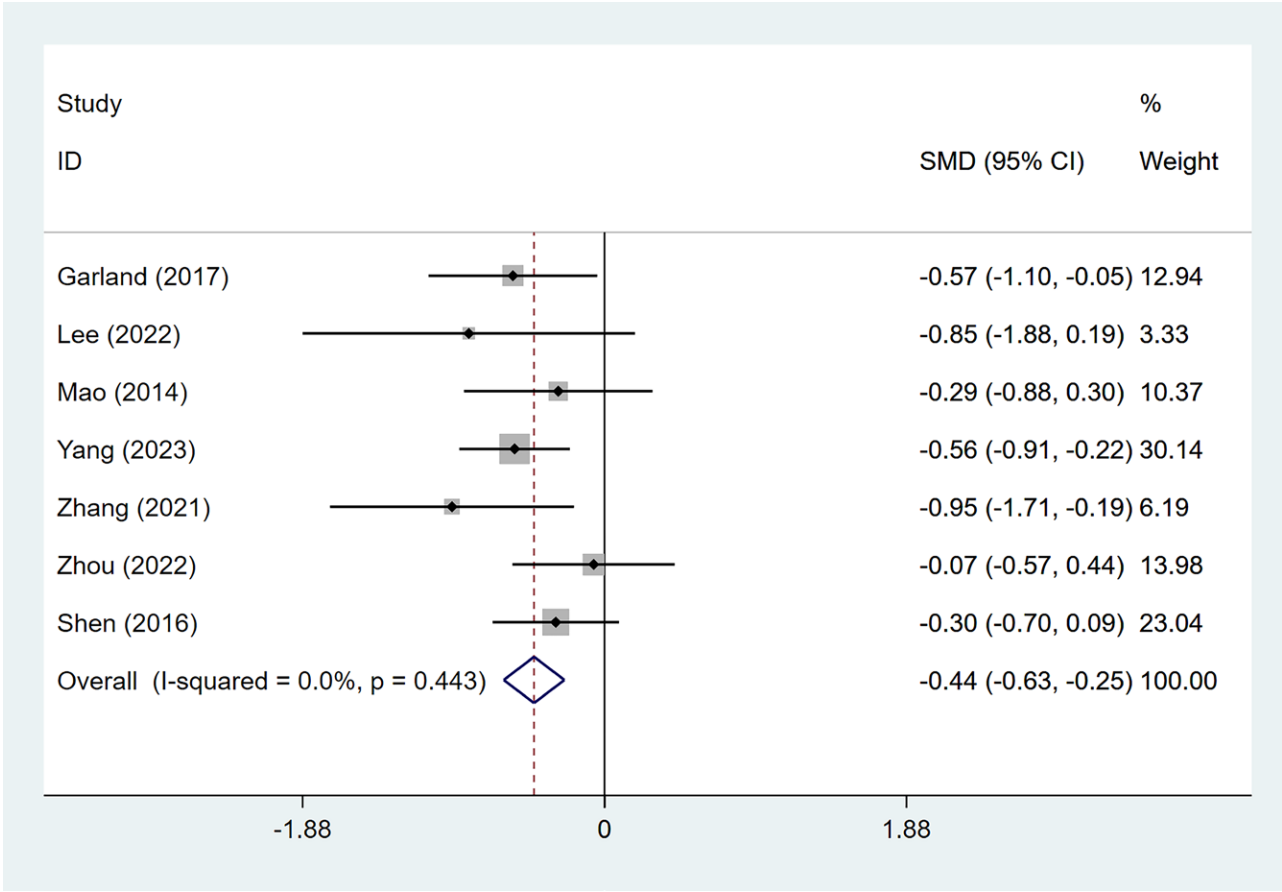


**Figure 4.** Forest plot of meta-analysis of Pittsburgh sleep quality index.

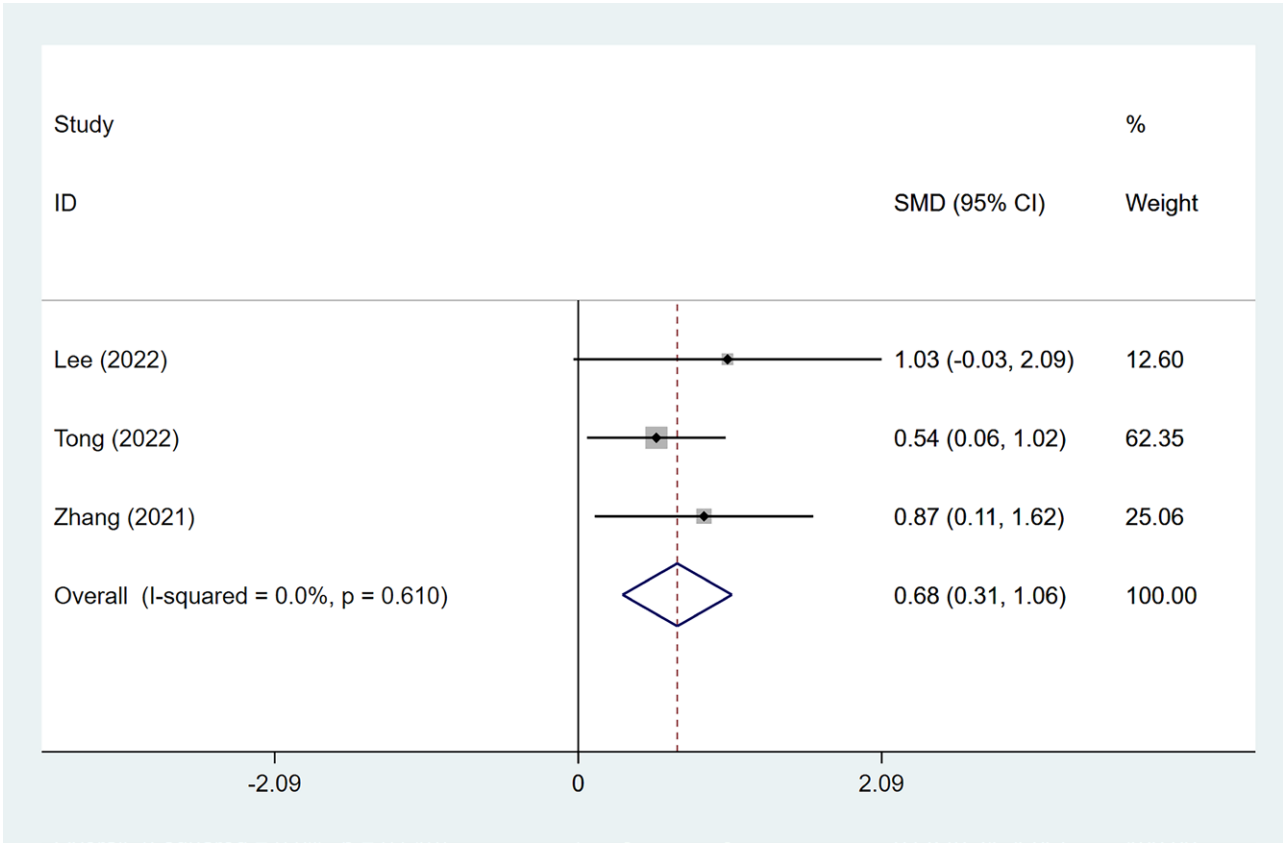


**Figure 5.** Forest plot of meta-analysis of total sleep time.

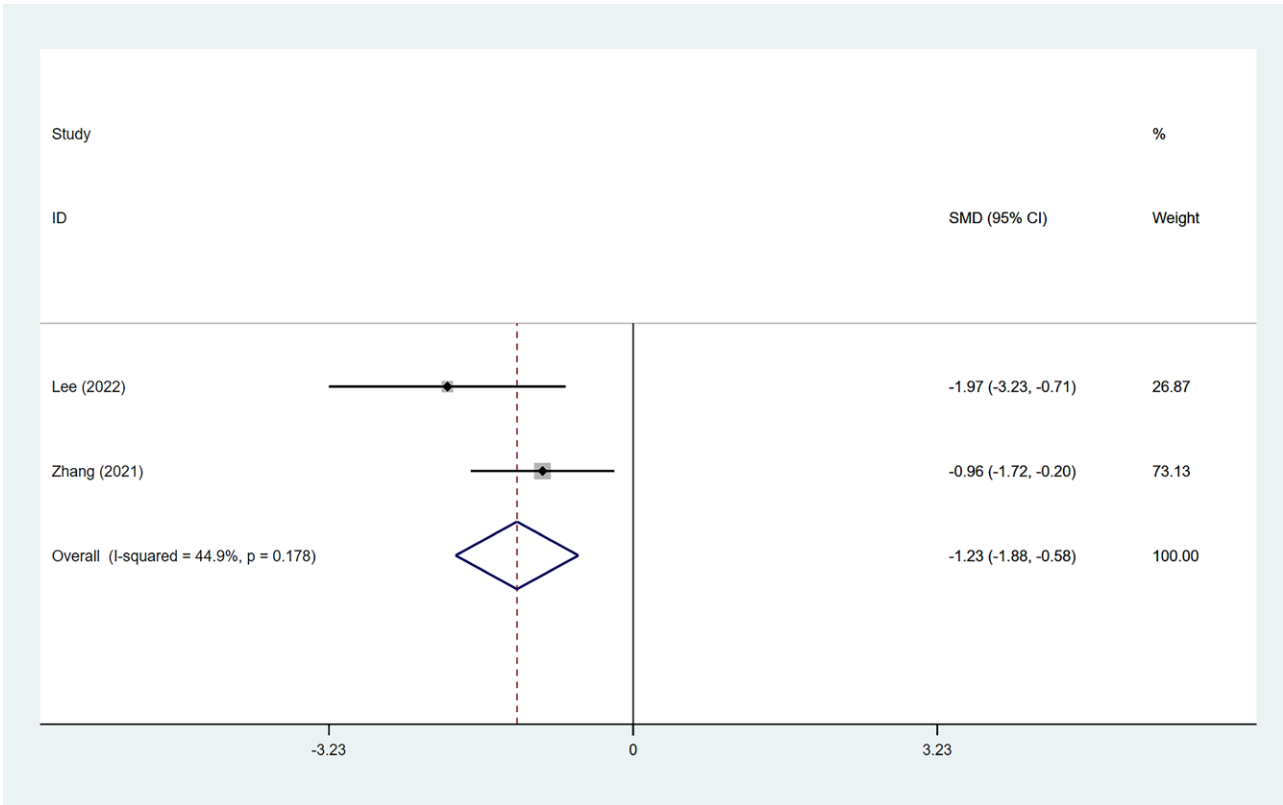


**Figure 6.** Forest plot of meta-analysis of insomnia severity index.

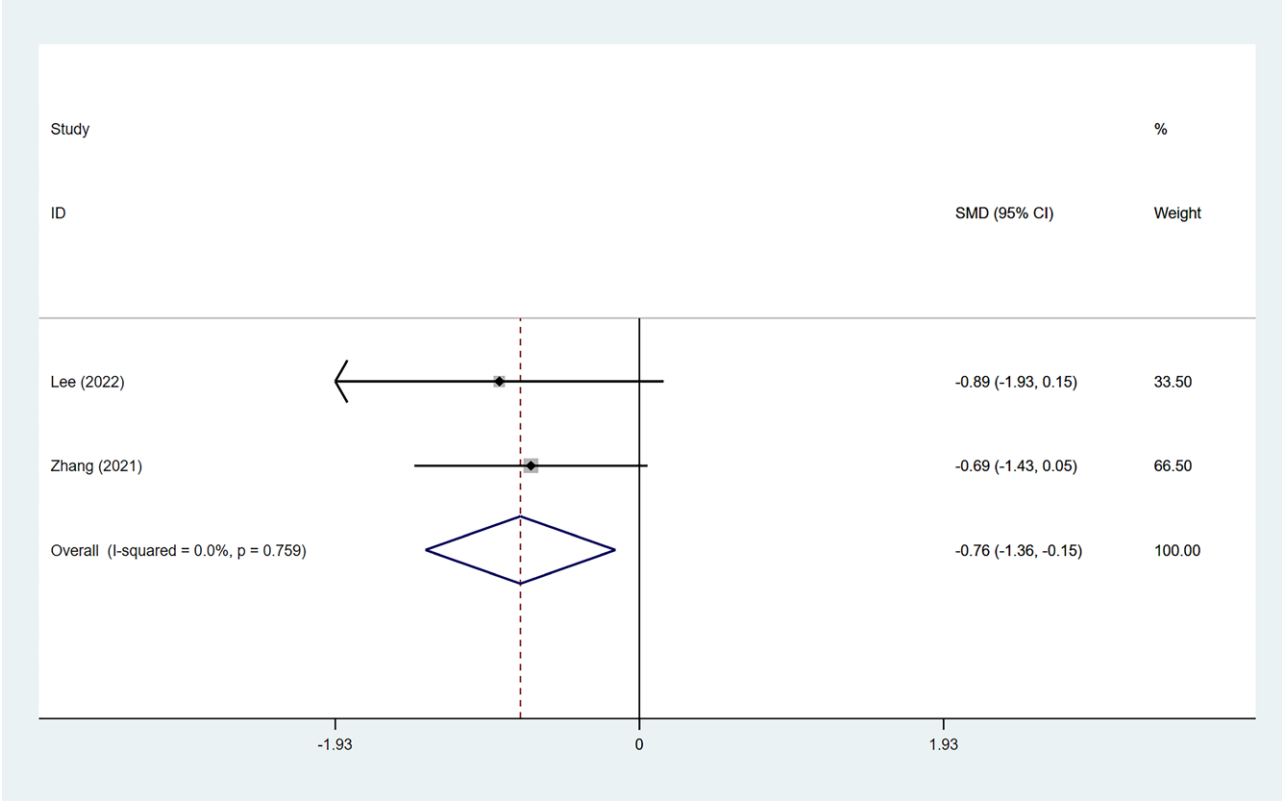


**Figure 7.** Forest plot of meta-analysis of Pittsburgh sleep onset latency.

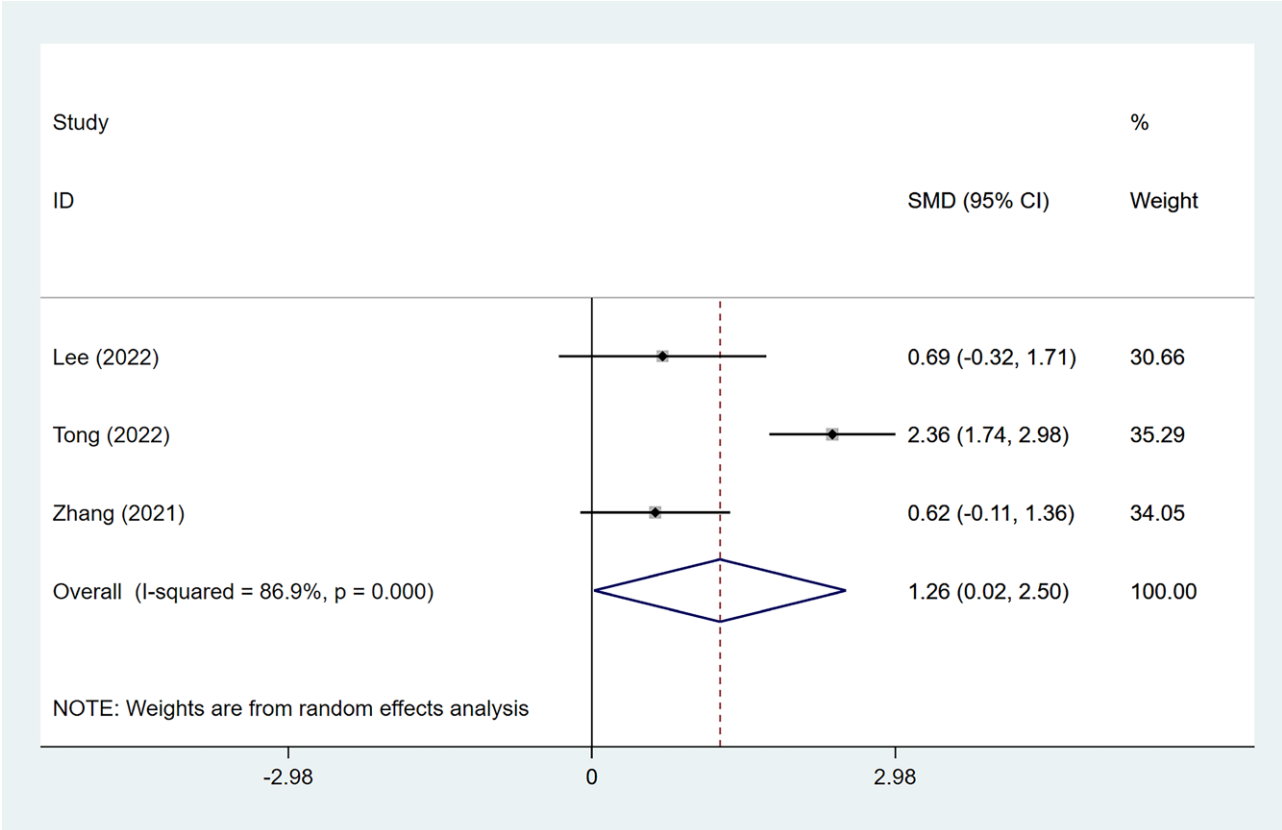


**Figure 8.** Forest plot of meta-analysis of Pittsburgh sleep efficiency.

credibility of our study. Second, the frequency, intensity, and duration of electroacupuncture used in the experimental groups of the included studies were not consistent, and the conventional treatment of the intervention in the control group was not consistent, which is also 1 of the potential limitations of our study. Third, the grade ratings of some of the outcome indicators were "low," which also affects the credibility of our conclusions.

## 5. Conclusion

Based on the current study, we found that electroacupuncture has a better effect on insomnia in cancer patients, but because of the large limitations of the study, we look forward to more high-quality randomized controlled studies to support our conclusions.

## Acknowledgments

We would like to thank the researchers and study participants for their contributions.

## Author contributions

**Conceptualization:** Ke Li, Ying Luo.
**Data curation:** Ke Li, Ying Luo.
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**Investigation:** Ke Li.
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**Project administration:** Ke Li.
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**Software:** Ke Li, Ying Luo.
**Supervision:** Ke Li.
**Validation:** Ke Li, Ying Luo.
**Visualization:** Ke Li.
**Writing – original draft:** Ke Li, Ying Luo.
**Writing – review & editing:** Ke Li.

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